DOCUMENT RESUME

ED 262 059 TM 850 534

AUTHOR Marschark, Marc; Carroll, Elizabeth
TITLE Developmental Changes in the Access of Referential and Associative Information by Pictures and Words. Research Bulletin #9.
INSTITUTION North Carolina Univ., Greensboro. Dept. of Psychology.
SPONS AGENCY National Inst. of Neurological and Communicative Disorders and Stroke (NIH), Bethesda, Md.
PUB DATE Jul 84
GRANT 1-R01120064-01
NOTE 35p.
PUB TYPE Reports - Research/Technical (143)

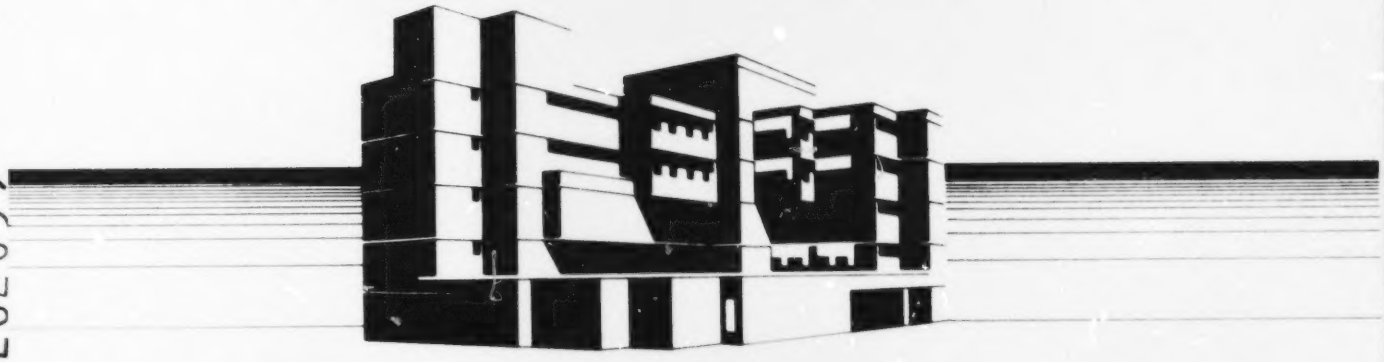
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Achievement Tests; *Age Differences; *Association (Psychology); Cognitive Development; Cognitive Style; Elementary Education; *Encoding (Psychology); Higher Education; Imagination; *Pictorial Stimuli; Reaction Time; Recall (Psychology); *Test Format; *Verbal Stimuli; Visualization; Word Recognition
IDENTIFIERS *Referential Communication

ABSTRACT

Three experiments examined referential and associative linkages in memory as a function of stimulus and response material formats. Second grade, sixth grade, and university students were the subjects. In Experiment 1, subjects pointed to either the picture or printed name of a stimulus corresponding to the name or picture, respectively, pointed to by the experimenter. In Experiment 2, the same subjects pointed to pictures or words uniquely identified by a verbal description read by the experimenter. Examination of the response times from these two experiments revealed that while referential links between picture and word representations of a concept become symmetrical by adulthood, associative links maintain a picture-response superiority. The latter finding was also obtained in Experiment 3, in which subjects pointed to picture or word response items in the same superordinate category as stimuli pointed to by the experimenter. (Implications for the development of verbal-to-imaginal and imaginal-to-verbal transformation abilities are discussed). (Author/GDC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

BEST COPY AVAILABLE



ED262059

DEVELOPMENTAL CHANGES IN THE ACCESS OF REFERENTIAL AND ASSOCIATIVE INFORMATION BY PICTURES AND WORDS

Marc Marschark and Elizabeth Carroll

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Marschark, Marc
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Research Bulletin #9 *July, 1984*

TM 850 534

LANGUAGE RESEARCH GROUP

DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

Developmental Changes in the Access of Referential and Associative Information by Pictures and Words

Marc Marschark and Elizabeth Carroll

University of North Carolina at Greensboro

Running Head: Referential and Associative Access

Send Proofs to: Marc Marschark, Ph.D.
Department of Psychology
University of North Carolina at Greensboro
Greensboro, NC 27412

Developmental Changes in the Access of Referential and Associative Information by Pictures and Words

ABSTRACT

Three experiments examined referential and associative linkages in memory as a function of stimulus and response material formats. In Experiment 1, second grade, sixth grade, and university students pointed to the picture or printed name of a stimulus corresponding to the name or picture, respectively, pointed to by the experimenter. In Experiment 2, the same subjects pointed to pictures or words uniquely identified by a verbal description read by the experimenter. Analyses of response times from these two experiments revealed that while referential links between picture and word representations of a concept become symmetrical by adulthood, associative links maintain a picture-response superiority. The latter finding also was obtained in Experiment 3 using a paradigm in which sixth grade and university students pointed to picture or word response items in the same superordinate category as stimuli pointed to by the experimenter. Implications for the development of verbal-to-imaginal and imaginal-to-verbal transformation abilities are discussed.

Although researchers have been interested in the relationships between imagery and verbal processes for decades, the dual coding model of Paivio (1971) provided the first comprehensive framework for investigating their differential effects on learning and memory. The work of Paivio and his colleagues has provided a wealth of information concerning the functional significance of imagery in comprehension, learning, and memory of adults (see Paivio, 1983, for a review) and spurred research with children by other workers (see Pressley, 1977; Yuille & Marschark, in press). A variety of studies have demonstrated the superiority of visual over verbal learning in children (the picture superiority effect) (e.g., Kee, Bell, & Davis, 1981; Pressley & Levin, 1977; Reese, 1970; Rohwer, 1970), and the effectiveness of partial pictures for inducing imagery and facilitating memory in learning tasks (e.g., Ruch & Levin, 1979). As Pressley (1977) noted, "No more experiments are required to substantiate the positive effect of pictures on children's learning" (p. 613).

Rather less research, however, has concerned the developing relationship between verbal and imaginal codes themselves, independent of their utility in learning. Bruner, Olver, & Greenfield (1966) assumed that imagery, or ikonic representations, formed an essential prerequisite for the establishment of symbolic representations. Piaget (1962; Piaget & Inhelder, 1972), in contrast, assumed that images and words were complementary and had distinct symbolic functions throughout the early years. Consistent with both views, Werner & Kaplan (1963) suggested an increasing "distancing " between things and

their mental representations with increasing age. Beginning with a relatively primitive level of functioning in which objects and their representations are scarcely distinguished from each other, objects, their verbal labels, and their mental representations become increasingly distinct or distant. Werner & Kaplan's position was similar to that of Piaget & Inhelder's (1972) insofar as imagery and language were both seen as early forms of symbolization, but, with Bruner et al. (1966) they assumed that imagery was a more primitive means of representation.

Paivio's (1971) view of conceptual development was similar to that of Werner & Kaplan (1963) and Bruner et al. (1966), at least insofar as he assumed imagery to play an essential role in the later acquisition of linguistic meaning (see also Macnamara, 1972). According to Paivio (1971), "Through exposure to concrete objects and events, the infant develops a storehouse of images that represent his knowledge of the world. Language builds upon this foundation and remains interlocked with it, although it also develops a partly autonomous structure of its own" (p. 437). Further, "[t]he interconnections between the verbal and non-verbal representational systems...develop concurrently with the verbal representations of concrete objects. That is, thing-names are ordinarily learned in the context of their referent situtations" (Paivio & Begg, 1981, p. 248).

This position is consistent with the informal observation that children's nonverbal interactions with the world are complemented (but never fully replaced) by verbal processing as language is acquired and becomes functional as a representational medium. Facility in transforming from from imaginal to verbal and verbal

to imaginal codes thus likely converges with age, as increased content and organization of the knowledge base provide richer (cf. Chechile & Richman, 1982) and more automated (McCauley, Weil, & Sperber, 1976; Marschark, Azmitia, & Paivio, 1984) interconnections between linguistic and perceptual information in memory. It is unclear, however, whether this cognitive dexterity ever reaches a point at which imaginal to verbal and verbal to imaginal referential transformations are symmetrical (i.e., take equivalent amounts of time). Examination of this question was the purpose of Experiment 1. Experiment 2 examined the fluency with which pictures and words could serve as response items in a simple verbal problem solving task. This was intended to assess the development of associative, rather than referential transformations. Experiment 3 extended Experiment 2 using a paradigm designed to distingush the stimulus and response functions of pictures and words and the encoding and decoding stages presumably involved in many picture-word tasks (see Paivio, 1970).

Experiment 1

Dilley and Paivio (1968) demonstrated that pictures facilitated learning when presented as stimuli, but hindered learning when presented as response items to four- to six-year-old children (see also, Kee et al., 1981; Rohwer, Kee, & Guy, 1975). Since the stimuli they used were familiar to their subjects, Dilley and Paivio suggested that pictures cause a decoding problem at a mediational level. That is, young children

had greater difficulty than adults in making the "symbolic transformation" from image to verbal response (Kee et al., 1981). Experiment 1 directly evaluated this hypothesis by examining the referential linkages between words and pictures in second graders, sixth graders, and university students using a simple word-picture and picture-word correspondence task. It was assumed that increasing automaticity in activating logogens (Morton, 1969) and imagens (Paivio & Begg, 1981) would be reflected in decreasing response times with increasing age. On the basis of Dilley and Paivio's (1968) findings, it was expected that responding to picture referents of word stimuli (i.e., decoding words) would be faster than responding to the printed names of pictures (i.e., decoding pictures), at least for second graders. Determining the extent, if any, of this picture-response superiority in sixth graders and university students was the primary objective.

Method

Materials, Design, and Procedures. Forty items were selected from first and second grade levels of several standardized achievement tests. The items included animals, food, vehicles, clothes, furniture, toys, and action verbs. These were arbitrarily divided into four sublists, each containing two exemplars from each of five different categories. Two of the sublists were designated to be presented as words and two others as pictures. Four 5 x 5 stimulus matrices then were constructed, two containing pictures and two containing words. The two

picture matrices each contained 20 different stimulus items (10 for each of two lists) and 5 fillers, all randomly organized. The two word matrices were constructed in parallel to the picture matrices (i.e., each contained items identical to one of the picture matrices), but the random organizations were different. The 25 locations in each matrix were drawn as 6.5 x 6.5 cm squares. The pictorial form of each item was a line drawing, approximately 5.5 x 5.5 cm in size. The word form of each item was printed with a black felt-tipped marker and regulated for size within the square.

The second and sixth graders were tested individually in rooms provided by the schools. The university students were tested individually in a laboratory room. To initiate each trial, the experimenter pointed to a picture or word and then immediately lifted a cover on the response array. Subjects then pointed to the word or picture (in another matrix), respectively, representing the same concept. Response time was recorded, using a digital stopwatch accurate to two decimal places, from the time the experimenter lifted the cover on the response array until the subject pointed to a response item.

Following 5 practice trials involving items not used on any test trials, the 16 subjects at each grade level received 10 picture-word and 10 different word-picture trials presented in counterbalanced blocks. Orders within each block were randomly determined. Although the intention was that each word and picture list would be presented to an equal number of subjects (8), one word list and one picture list inadvertently were presented to 10 subjects and the others to 6 subjects in the

university sample. In all other cases, both word and picture lists were presented to 8 subjects each.

In addition to the primary task described above, normative imagery ratings were obtained for the 40 stimulus words by having a group of university students (not in the primary task) rate them on a seven point scale where 1 represented "arouses a mental image with difficulty or not at all" and 7 represented "arouses a mental image very quickly and easily." This task was subject-paced.

Subjects. The subjects in the primary task were 16 second graders (8 females) and 16 sixth graders (6 females) enrolled in local public schools, and 16 undergraduates (13 females) enrolled in an introductory psychology course at UNC-Greensboro. An additional 33 subjects (approximately 75% female) from the latter pool participated in the normative rating session.

Results and Discussion

Response times longer than 15 seconds were truncated to that value. This amounted to 4.7% of the total trials for the second graders, <1% for the sixth graders, and 1.2% for the university sample. Mann-Whitney tests at each grade level revealed no reliable differences in response times as a function of counterbalancing or sublist (array) for either pictures or words. The data therefore were collasped across both. Unless noted otherwise, all results reported were reliable at a .05 level.

Insofar as all of the stimuli were concrete and highly familiar, it was not surprising that the range in mean imagery

values was relatively small, from 3.85 to 6.82 on the 7-point scale. Correlations of the separate picture and word response times with the mean imagery rating of each stimulus item and the number of letters in each word revealed no reliable relationships, all rs (18) < .25.

Response times then were analyzed using a 3 (grade) x 2 (picture or word) mixed-design analysis of variance. The data are depicted in Figure 1 where it can be seen that response time varied directly with grade, $F(2,45) = 16.59$, MSe = 2.08, and that picture response items were pointed to faster than word response items, $F(1,45) = 27.94$, MSe = .73.[1] In addition, there was a marginally reliable interaction of grade and response modality, $F(2,45) = 2.47$, $p < .10$. A priori t-tests revealed that pictures were responded to significally faster than words by second graders $t(45) = 4.30$, and sixth graders $t(45) = 3.38$, but not by the university students, $t(45) = 1.36$. Thus, while the university students were equally facile in picture-to-word and word-to-picture transformations, sixth graders as well as second graders appeared to suffer the picture-to-word transformation deficit observed by Dilley and Paivio (1968) in 4- to 6-year-olds.

Because of the importance of the null finding in the university sample, a replication of the experiment with a comparable group was conducted. Eight UNC-Greensboro graduate students were administered 10 trials, 5 picture-word and 5 word-picture, in counterbalanced orders. The stimuli were different from those used in Experiment 1, but were similarly constructed

from the larger pool of stimuli orininally selected. The mean response time for picture-pointing trials was 2.42 and that for word-response trials was 2.53. The difference was not reliable, $t(7)=0.41$.

- - - - - - - - - - - - - - - - - - -

Insert Figure 1 about here

- - - - - - - - - - - - - - - - - - -

These results indicate that the increasing superiority with age of pictures over words as response items and imaginal over verbal strategies in learning tasks (Kee et al., 1981; see Pressley, 1977) is accompanied by a decrease in the asymmetry of referential linkages between words and pictures. Facile decoding of nonverbal mediators, of course, must be a prerequisite for the observed effective use of imaginal strategies in older children, and increasing automaticity and bidirectionality in referential connections seem an important component of that increasing facility.

In order to determine the generality of the findings from Experiment 1, a second experiment was conducted, using the same subjects and materials. Experiment 2 further examined the development of verbal-nonverbal connections in memory through a task that required pointing to a picture or word uniquely described by a preceding verbal statement containing the item's superordinate category and an associatively related characteristic. In line with the preceding discussion, it was assumed that with increasing age there would be a general decrease in response times, and that pictures would be responded

to faster than words, at least by the second graders. That is, verbal descriptions would activate imaginal representations of their referents faster than their verbal labels. The central question was whether this associative task would reveal a convergence in the times required to access verbal and nonverbal representations (indicated by word and picture response modes, respectively). Such convergence would indicate age-related increases in the symmetry of associative access to imaginal and verbal representations in memory, beyond the referential links tapped by Experiment 1. Lack of convergence (reliable divergence seemed theoretically unlikely) would suggest a consistent primacy of imaginal processing (i.e., verbal-to-imaginal transformation) in verbal associative problem solving akin to the picture superiority effect observed in paired-associate learning.

Experiment 2

Method

Materials and Procedure. The same materials used in Experiment 1 were used here. For each of the 40 stimulus items, a "riddle" was constructed that contained a category clue, which always came first, and a unique characteristic clue. The riddle for duck, for example was "what is an animal that quacks?" The riddle for airplane was "what is something you ride in that flies in the air?" Following each question, a subject was shown a 5 x 5 array of pictures or words. Responses were made by pointing to the unique item which represented the answer to the riddle. Ten

trials requiring a picture-pointing response and 10 requiring a word-pointing response were administered in counterbalanced blocks. Orders within blocks were randomly determined. No item was used as both a picture response and a word response for a single subject. Each stimulus matrix was used an equal number of times for each subject, and each list was presented to eight subjects at each grade level. Five practice trials were composed of items not used on test trials. Response times were recorded from the time the examiner lifted the cover from the response array (immediately after reading a riddle) until the subject pointed to a response item. Response times were measured with a digital stopwatch accurate to two decimal places.

Subjects. The subjects in Experiment 2 were the same second grade, sixth grade, and university subjects who had participated in the referential task of Experiment 1. Each was tested in the same session in which they participated in Experiment 1, but using a different stimulus list.

Results and Discussion

There were no errors in response choices for any subjects, indicating that even the second graders could solve the simple, orally-presented riddle problems. Response times longer than 15 seconds were truncated to that value. This amounted to 12% of the responses of the second graders, <1% of responses for the sixth graders, and 3% of the responses for the university sample. As in Experiment 1, there were no reliable effects due to

counterbalancing order or sublists; the data therefore were collapsed across list and block order.

Mean response times for pictures and words at each grade level are depicted in Figure 2. As in Experiment 1, word length was unrelated to response times on both picture and word trials at all grade levels, all *r*s (18) < .33. Mean imagery ratings of the items were reliably related to response times only in the university students' responding to word stimuli, where more imageable items were responded to faster, *r* (18) = -.40.

- - - - - - - - - - - - - - - - - - - -

Insert Figure 2 about here

- - - - - - - - - - - - - - - - - - - -

The response time data were analyzed using a 3 (grade) x 2 (picture or word) mixed-design analysis of variance. Overall, response times decreased with increasing grade, *F*(2,45) = 24.17, MSe = 1.47, and pictures were responded to faster than words, *F*(1,45) = 38.03, MSe = 1.11. The grade by input modality interaction was not reliable, *F*(2,45) = 1.36, as *t*-tests indicated the picture advantage to be reliable at all three grade levels, all *t*s (45) > 2.85.

These results suggest that although referential links between pictures and words become symmetrical by adulthood, associative relationships do not (see also, Marschark et al., 1984). Some caution is in order, however, for three reasons. First, although the riddles were constructed arbitrarily, it may be that some of the "unique characteristics" were attributes depicted in the line

drawings but not particularly salient with respect to the stimulus concepts and thus not likely activated initially on presentation of the verbal description or examination of the verbal response alternatives (Marschark, 1983). This would result in the picture superiority effect observed at all ages here, but artifactually so. Second, the present results might have been at least partially a consequence of reading times for the word response items. This explanation is unlikely, however, given that similar reading demands existed in Experiment 1, and the university subjects responded to the words essentially as quickly as they did to pictures. Moreover, there was no apparent relationship between word length and response times in either experiment (see also, Potter, 1975). Third, since the stimuli here were all verbal (descriptions), the conditions were not exactly comparable to those of Experiment 1. A definitive assessment of associative asymmetries in verbal-nonverbal processing requires the use of pictures and words as both input and output items. Experiment 3 therefore was designed to provide a more direct test of developmental differences in associative retrieval to pictures and words, using a paradigm that eliminated these three sources of difficulty.

Experiment 3

On each trial of Experiment 3, sixth graders and university students were shown a picture or a word (in one matrix) and had to point to a picture or word (in another matrix) that represented an exemplar of the same superordinate category. Second graders were not tested here, since Experiments 1 and 2

indicated that the devlopmental changes of interest occur between sixth grade and adulthood.

The conceptual design of Experiment 3 is shown in Figure 3. Given either a picture or word as an input (stimulus) item, it was assumed that the superordinate category concept would be activated and then a search initiated for an appropriate output (response) item. Beyond providing a test of the symmetry of picture and word associative relations, this design also provided a means of examining the representational modality of category superordinates for sixth grade and university students. Most obviously, a consistent input and output advantage for either pictures or words would indicate the category concept to be relatively more imaginal (Anderson & McGaw, 1973) or linguistic (Underwood & Richardson, 1956; cf. Paivio, 1971, e.g., p.287; Potter & Faulconer, 1975). Alternatively, superordinate information might be simultaneously available in distinct verbal and imaginal systems, accessible by words and pictures, respectively. Consistent with an encoding specificity framework (e.g., Tulving, & Thompson, 1973) this would result in faster responses when both stimuli and responses are in the same format (WW and PP) than in different formats (WP and PW).

Evaluation of the above possibilities requires that the model depicted in Figure 3 be schematically correct in having a stage of superordinate category access rather than direct associations among same-category exemplars through, for example, visual or orthographic similarity. The accuracy of the model can be assessed by examining picture-word differences on input and

output sides, holding the other (output and input, respectively) constant. If the model is correct, then (1) should be true, using the notation of Figure 3, and where W_{IO}, for example, refers to the mean response time from trials involving word input and word output.

(1) $$W_{IW} - P_{IW} = W_{IP} - P_{IP}$$

This is because the two differences are entirely a function of encoding processes. Similarly, (2) should be correct because the two differences are entirely a function of decoding processes.

(2) $$W_{IW} - W_{IP} = P_{IW} - P_{IP}$$

- - - - - - - - - - - - - - - - - - -

Insert Figure 3 about here

- - - - - - - - - - - - - - - - - - -

Now, if at any given age associative links between verbal and imaginal codes are symmetrically available to picture and word inputs (as are referential links), then there should be no reliable effect of item format in this task. If associative links maintain their picture superiority as suggested by Experiment 2, however, pictures should lead to faster responding than words.

Method

Materials, Design, and Procedure. Thirty-two stimulus items were drawn from the same sources used for Experiment 1. There

were eight exemplars for each of four categories: animals, food, vehicles, and furniture. Word and picture stimuli were prepared as in Experiments 1 and 2. Stimulus items were compiled into 5 x 5 matrices, eight with pictures and eight with words. One item from each category was represented in each matrix, the remaining spaces containing filler items not representing any of the four designated categories, but all comparable to the stimulus items in familiarity, size, and complexity. Placement of all objects on all arrays was random.

The four target categories were described twice to each subject. Subjects were told that they were to point to the picture or word on one array that was a member of the same category as the picture or word pointed to by the examiner on a different array. Following 5 practice trials, 16 trials (all different stimuli) were administered in four counterbalanced blocks (four each of W-W, W-P, P-W, P-P), the subjects and experimenter changing matrices after each trial. Categories and exemplars also were counterbalanced across subjects. Response time was recorded (using a stopwatch accurate to two decimal places) from the time the examiner pointed to an exemplar on one matrix until the subject pointed to an item from the same category on the other matrix.

Subjects. The subjects were 16 sixth graders (9 females) and 16 undergraduate students (10 females). The former were enrolled in a local public school and the latter were enrolled in an introductory psychology course at UNC-Greensboro.

Results and Discussion

No errors were made in the responses of any subjects, indicating that the materials were clearly classifiable in terms of the four categories and that all subjects understood the task. Response times greater than 15 seconds were truncated to that value. This amounted to 7% of the sixth graders' responses and 3.5% of the university students'. The mean response times for the four different presentation conditions are depicted in Figure 4. These data first were analyzed using a 2 (grade) x 2 (word or picture input) x 2 (word or picture output) mixed-design analysis of variance. Overall, university students responded faster than sixth graders, $F(1,30) = 6.41$, $MSe = 8.23$. Although the picture-word difference was not reliable on input, $F(1,30) = 1.57$, pictures were responded to much faster than words on output $F(1,30) = 39.05$, $MSe = 6.23$ (see Figure 4). The input x output interaction was not reliable, however, $F(1,30) < 1$, $MSe = 3.04$.

The lack of any grade-related interactions replicated the results of Experiment 2 and indicated that, unlike referential transformations, associative "decoding" maintains a word-to-picture superiority, relative to picture-to-word decoding, into adulthood (Dilley & Paivio, 1968). The developmental difference observed in response times cannot be ascribed to either a generic exemplar-category "encoding" or category-exemplar "decoding," as both were .4 seconds faster for university than sixth grade students. Rather, those differences appear to reflect an "across-the board" developmental increase in both encoding and decoding.

Insert Figure 4 about here

With regard to determining the representational modality of category superordinates in memory, the viability of the model depicted in Figure 3 was evaluated by comparing the differences in response times between pictures and words as input items separately for picture and word output items and as output items separately for picture and word input items (i.e., WW - WP, PW - PP, and WW - PW, WP - WW, respectively, see Figure 3 and equations 1 and 2). The mean response times for each input-output combination are depicted in Figure 4. Consistent with the model, for both sixth grade and university samples the differences between pictures and words as input stimuli were the same for each of the output forms. For the sixth grade sample, the picture-word input difference given words as output was .6 sec and the picture-word difference given pictures as output was .1 sec, $\underline{t}(15) = 1.17$. The picture-word output difference given words as input was 3.1 sec and, given pictures as input was 3.6 sec, $\underline{t}(15) = .50$. For the university sample, the picture-word input difference given words as output was .4 sec and with pictures as output was .5 sec, $\underline{t}(15) = .17$. The picture-word output difference given words as input was 1.7 sec, and given pictures as input was 2.6 sec, $\underline{t}(15) = .11$.

The finding that pictures as response items were responded to faster than words might be thought to indicate that whatever the mental representation of superordinate categories, they are more similiar to pictures than to words. This position, however,

requires a picture superiority in the exemplar-category link comparable to that in the category-exemplar link (see Figure 3), a finding not obtained with either sixth graders or university students. The encoding specificify alternative also is not supported, since same-format response times were no longer than different-format response times (see Figure 4).[2]

The most likely interpretation of the present findings thus appears to be that at least by Grade 6, salient category superordinates are memorially represented in some form equally accessible by word and picture inputs. The picture-response superiority observed here and by Potter and Faulconer (1975) could have arisen from the differential availablity of category information in the identification of pictures and words as response items. That is, presumably the first information available on presentation of word stimuli includes phonetic and articulatory information, word identity, and then closely related referential and associative information, including an image of the referent and salient attributes (Marschark, 1983; McCauley et al., 1976). By Grade 6, however, pictures may more directly activate associative category information so that after identifying a picture stimulus, information is immediately available, bypassing the phonological stage. Consistent with this suggestion, Potter and Faulconer (1975) found pictures to be categorized much more quickly than they could be named, and Potter (1975) found that words could be categorized even when presented at a rate that precluded their naming or imaging.

Summary and Conclusions

Paivio (1970, p.390) noted the importance of distinguishing "the stimulus and response functions of items, and the encoding and decoding stages" involved in developmental tasks using verbal and visual stimuli. The present experiments have attempted to do so, and the findings bear on several issues. In Experiment 1, subjects in second and sixth grades pointed to pictures of stimuli in response to the experimenter's pointing to their printed names faster than they pointed to the printed names given the experimenter's pointing to pictures. This referential word-to-picture superiority parallels the deficiency observed by Dilley and Paivio (1968) in young children's decoding of imaginal mediators to yield verbal responses in a paired-associate task. The finding that this transformational asymmetry (as compared to word-to-picture transformations) was absent in the university sample was taken as evidence that by adulthood picture-to-word and word-to-picture referential linkages are functionally automated in both directions (Paivio, 1971, Ch. 2).

The developmental decrease in response times observed in the picture decoding deficit seems an essential precursor of the picture superiority effect observed by several researchers in paired-associate learning (e.g., Kee et al., 1981; Pressley & Levin, 1977; Rohwer et al., 1965). Images could not serve as a superior mode for paired-associate learning unless they could be referentially decoded in recall. Although further, individual differences research is clearly needed, it seems likely that increases in the picture superiority effect in learning tasks

will be found to track, slightly behind, decreases in the picture decoding deficit observed in Experiment 1.

The results of Experiments 2 and 3 indicated that while picture-to-word and word-to-picture referential linkages become relatively symmetrical by adulthood, comparable access to associative linkages do not. This was evidenced in the consistent superiority observed for the decoding of words to pictures as compared to the reverse, even for the university samples. The one-to-many nature of the relationships between a concept and its associates as compared to the one-to-one or one-to-few nature of those between a concept and its printed name or visual referent are such that symmetry in picture and word access to associative linkages is extremely unlikely, except, perhaps, for extremely close associates. Although these were excluded from the present study, it is possible that concepts in pairs like dog cat or table chair might be strongly enough associated both to each other and their superordinate categories that they might not yield a picture advantage on the response side of the paradigm used in Experiment 3 (see Figure 3). This also is need of further investigation.

Finally, the results of Experiment 3, as depicted in Figure 4, shed some light on modality effects in categorical judgment tasks. Potter and Faulconer (1975) found that line drawings could be categorized 50 msec faster than could words. Rather than concluding that superordinates are represented in some image-like form (a conclusion that would seem required by that finding, see Paivio, 1971), they suggested that superordinates are represented in some form that is neither visual nor verbal but is more

accessible to visual than verbal inputs. While no source of support for that conclusion was provided in the Potter and Faulconer (1975) report, the results of the present Experiment 3 seem to do so. At least by grade 6, the categories of furniture, toys, animals, and food appear to associatively available, rather directly, to both picture and word stimuli.

References

Anderson, R.C. & McGaw, B. (1973). On the representation of the meanings of general terms. Journal of Experimental Psychology, 101, 301-306.

Bruner, J.S., Olver, R.R. & Greenfield, P.M. (1966). Studies in cognitive growth. New York: John Wiley.

Chechile, R.A. & Richman, C.L. (1982). The interaction of semantic memory with storage and retrieval processes. Developmental Review, 2, 237-250.

Dilley, M.G. & Paivio, A. (1968). Pictures and words as stimulus and response items in paired-associate learning of young children. Journal of Experimental Child Psychology, 6, 231-240.

Kee, D.W., Bell, T.S. & Davis, B.R. (1981). Developmental changes in the effects of presentation mode on the storage and retrieval of noun pairs in children's recognition memory. Child Development, 52, 268-279.

Macnamara, J. (1972). Cognitive basis of language learning in infants. Psychological Review, 79, 1-13.

Marschark, M. (1983). Semantic congruity in symbolic comparisons: Salience expectancy, and associative priming. Memory and Cognition, 11, 192-199.

Marschark, M., Azmitia, M., & Paivio, A. (1984). Associative access in symbolic comparisons by adults and children. Manuscript submitted for publication.

McCauley, C., Weil, C. & Sperber, R. (1976). The development of memory structure as reflected by semantic priming effects. Journal of Experimental Child Psychology, 22, 511-518.

Morton, J. (1969). Interaction of information in word recognition. Psychological Review, 76, 165-178.

Paivio, A. (1970). On the functional significance of imagery. Psychological Bulletin, 73, 385-392.

Paivio, A. (1971). Imagery and verbal processes. Hillsdale, N.J.: Erlbaum (reprinted).

Paivio, A. (1975). Preceptual comparisons through the mind's eye. Memory and Cognition, 3, 635-647.

Paivio, A. & Begg, I. (1981). Psychology of language. Englewood Cliffs, N.J.: Prentice Hall.

Piaget, J. (1962). Play, dreams, and imitation in childhood. New York: Norton.

Piaget, J. & Inhelder, B. (1972). Mental imagery in the child. New York: Basic Books.

Potter, M.C. (1975). Meaning in visual search. Science, 187, 965-966.

Potter, M.C. & Faulconer, B.A. (1975). Time to understand pictures and words. Nature, 253, 437-438.

Pressley, M. (1977). Imagery and children's learning: Putting the picture in the developmental perspective. Review of Educational Research, 47, 585-622.

Pressley, M. & Levin, J.R. (1977). Developmental differences in subjects' associative learning strategies and performance: Assessing a hypothesis. Journal of Experimental Child Psychology, 24, 431-439.

Reese, H.W. (1970). Imagery and contextual meaning. Psychological Bulletin, 73, 404-414.

Rohwer, W.D., Jr. (1970). Images and pictures in children's learning. Psychological Bulletin, 73, 393-403.

Rohwer, W.D., Jr.; Kee, D.W., & Guy, K,C. (1975). Developmental changes in the effects of presentation media on noun-pair learning. Journal of Experimental Child Psychology, 19, 137-152.

Ruch, M.D & Levin, J.R. (1979). Partial pictures as imagery-retrieval cues in young children's prose recall. Journal of Experimental Child Psychology, 28, 268-279.

Tulving, E. & Thompson, D. (1973). Encoding specificity and retention processes in episodic memory. Psychological Review, 80, 352-373.

Underwood, B.J. & Richardson, J. (1956). Some verbal materials for the study of concept formation. Psychological Bulletin, 53, 84-95.

Werner, H. & Kaplan, B. (1963). Symbol formation: An organismic-developmental approach to the psychology of language and the expression of thought. New York: John Wiley.

Yuille, J.C. & Marschark, M. (in press). Imagery and children's learning: An issue of declining developmental interest? International Review of Mental Imagery.

Footnotes

1. While words generally can be read faster than pictures can be labeled (Paivio, 1971), simply reading a word without accessing its referent would be insufficient for this task, and picture naming was unnessary.

2. While seemingly inconsistent with dual coding assumptions about processing within and between symbolic systems (Paivio, 1975), 2), Paivio (personal communication, May 30, 1984) has suggested that such reaction time asymmetries are nowhere ruled out by any assumptions of the model.

Acknowledgments

The order of authorship was determined by a coin toss. The research reported herein was supported by grant # 1-R0120064-01 to Marc Marschark from the National Institute of Neurological and Communication Disorders and Stroke. The authors wish to express their appreciation to Donna Frick for her assistance throughout this project, to Charles Richman for his comments on the manuscript and for suggesting Experiment 3, and to the students, teachers, and administrations of the General Greene School and Konnoak Elementary School for their cooperation. Correspondence should be addressed to Elizabeth Carroll, Department of Child Development and Family Relations, Stone Hall, University of North Carolina at Greensboro, Greensboro, NC 27412, or Marc Marschark, Ph.D., Department of Psychology, University of North Carolina at Greensboro, Greensboro, NC 27412.

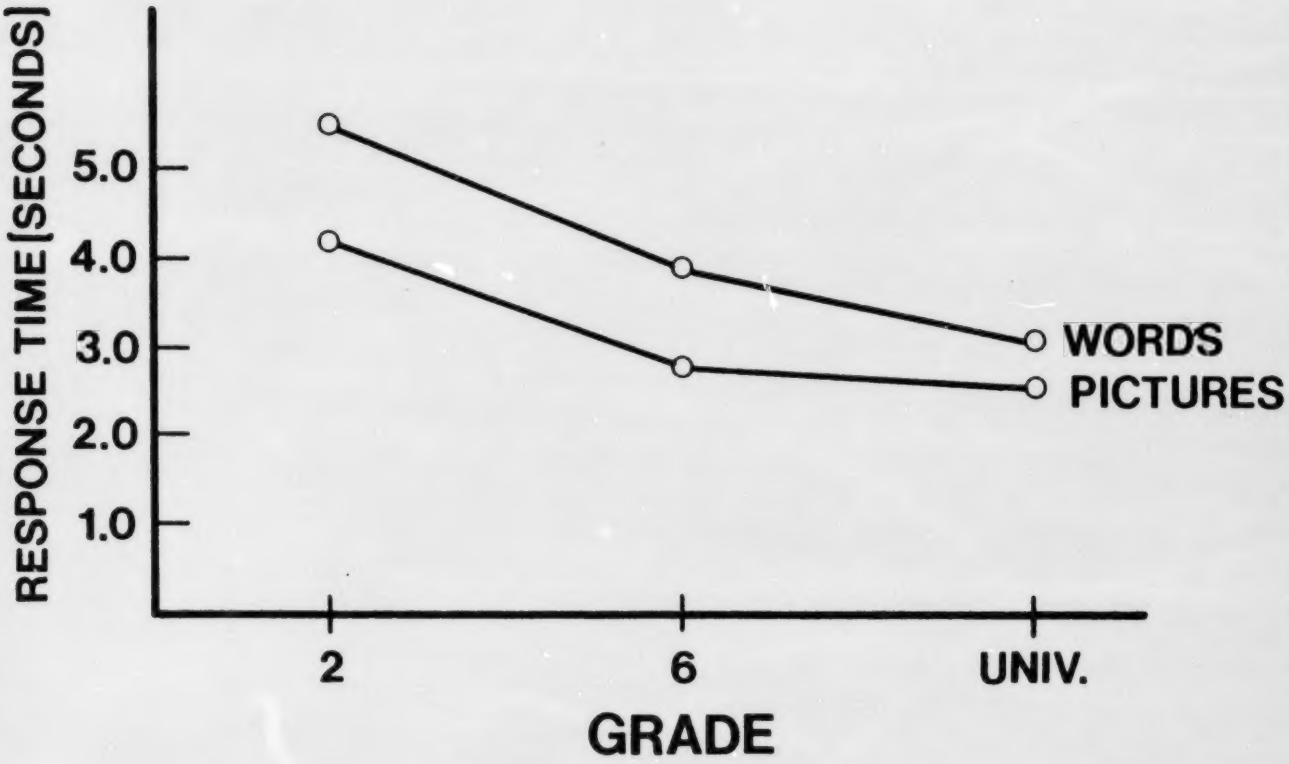
Figure Captions

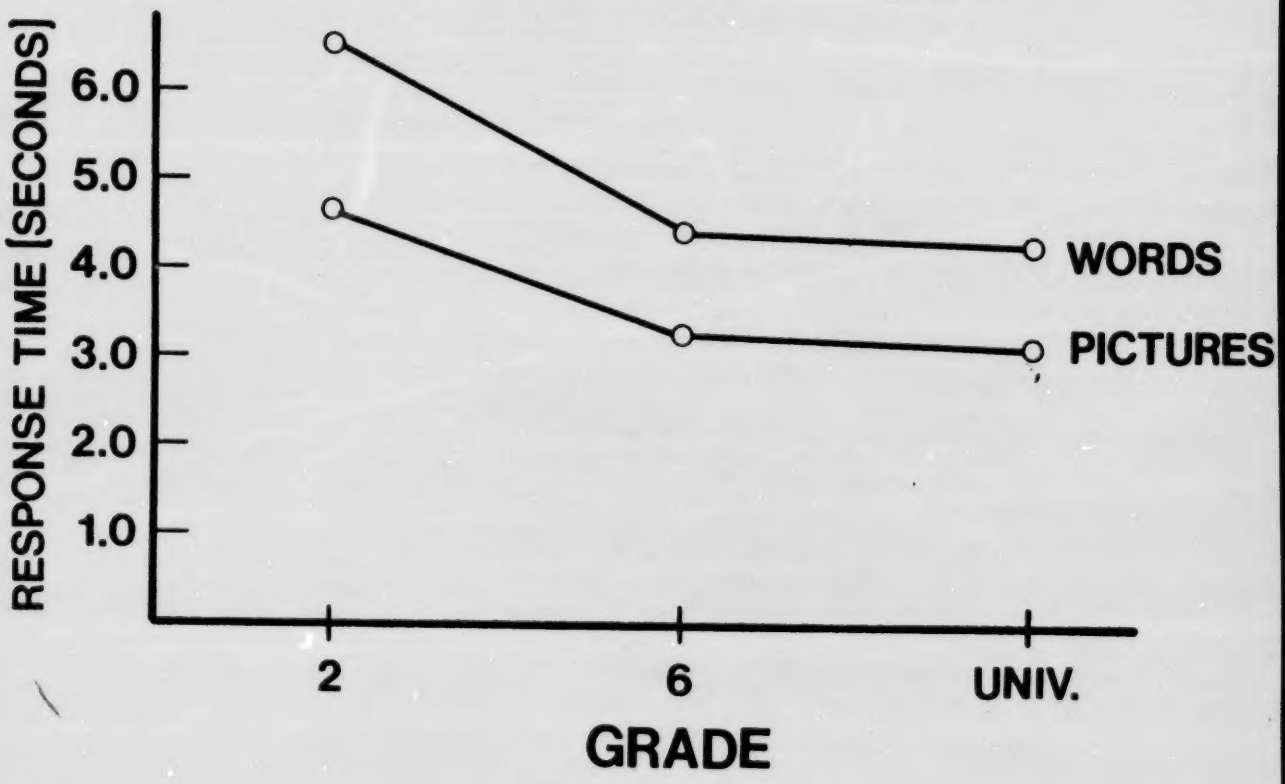
1. Mean response times for word-to-picture (PICTURES) and picture-to-word (WORDS) trials in the referential task of Experiment 1.

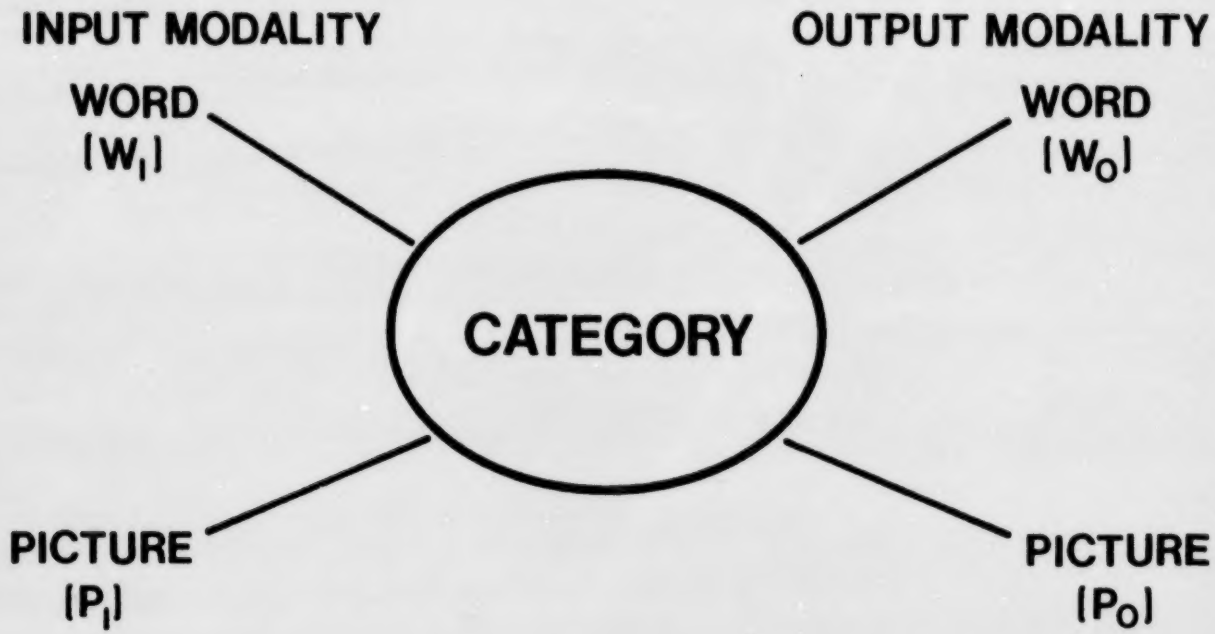
2. Mean response times for word-response (WORDS) and picture-response (PICTURES) trials of the verbal associative task of Experiment 2.

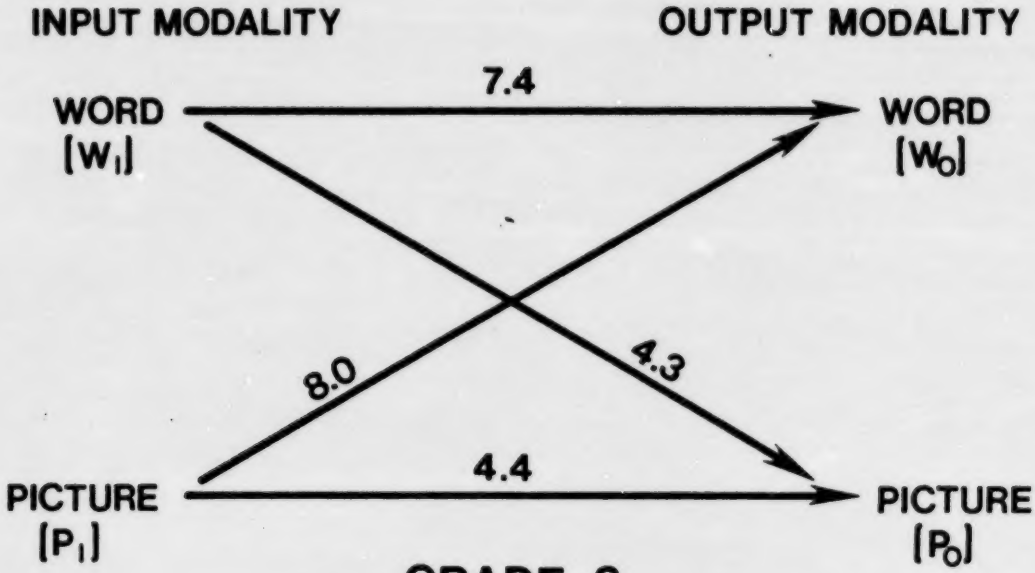
3. Schematic model for design of Experiment 3.

4. Mean response times for orthogonal pairings of picture and word stimulus and response items in category association task of Experiment 3.

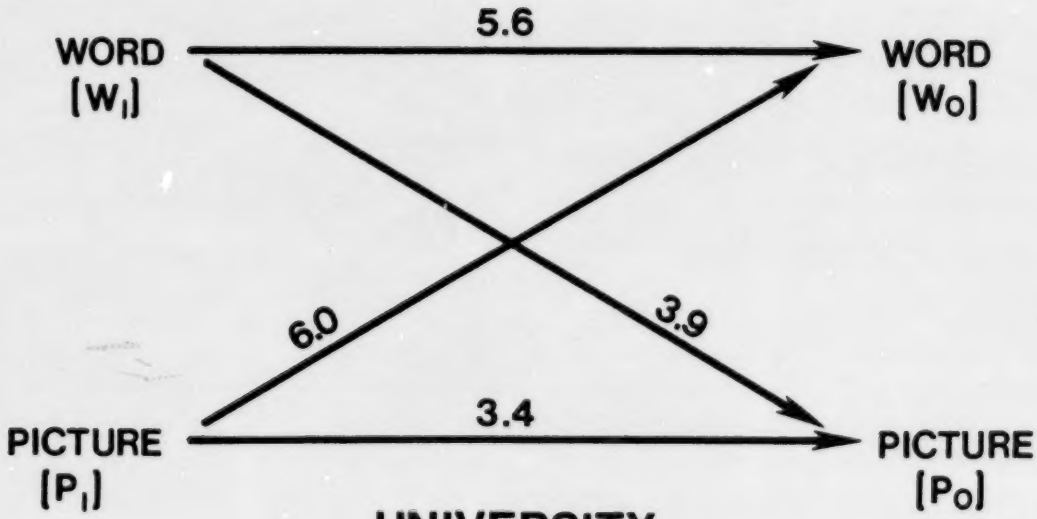

RESPONSE TIME (SECONDS)
5.0
4.0
3.0
2.0
1.0
2
6
UNIV.
GRADE
WORDS
PICTURES


RESPONSE TIME [SECONDS]
6.0
5.0
4.0
3.0
2.0
1.0
WORDS
PICTURES
2
6
UNIV.
GRADE


INPUT MODALITY
WORD
[W_I]
OUTPUT MODALITY
WORD
[W_O]
CATEGORY
PICTURE
[P_I]
PICTURE
[P_O]



GRADE 6



UNIVERSITY